PRELIMINARY INSTRUCTION BOOK

for

DETECTOR AMPLIFIER AN/UPA-1

SHIPS 271

CONFIDENTIAL

(Non-Registered)

MANUFACTURED
BY
BELMONT RADIO CORPORATION
CHICAGO 39, ILLINOIS
FOR
U. S. NAVY DEPT. BUREAU OF SHIPS

Contract NXsr 69266 *Approved 20 November 1944*

CONFIDENTIAL

ADDENDA

to

PRELIMINARY INSTRUCTION BOOK

for

DETECTOR AMPLIFIER AN/UPA-1

SHIPS 271

The following corrections and additions are to be made in the instruction book noted above. These changes apply to those units serial numbered from 2 through 81.

Page 1-1 Par. 4. Add the following to the table of equipment supplied: 1 Detector Adapter Cable; 14" RG-9/U, two plugs #49190; weight, .48.

Page 6-3 Add: P-104; 49190; PLUG: Part of W-105.; Function, Plug on detector adapter cable; Manufacturer, Amphenol, type 83 1SP; Drawing, B-55A-2244.

Page 6-5 Add: W-105; CABLE: Detector to video attenuator; RG-9/U cable, 14" lg; P-104 on each end.; Function, Detector adapter cable.; Manufacturer, BRC ; Drawing, B-201-1732.

Page 3-2 On the schematic diagram, add choke L106 in the line connecting the screen grid (term. 6) of tube V101 with the screen grid (term. 6) of tube V102.

Page 6-3 Add the following item after L-105: L-106; INDUCTOR: Choke coil; 20 turns tight wound; wire 28SSE; self resonance 206 m.c. 3%.; Screen isolation; BRC; A-207-1346; 1; 1; 3.

Page 7-1 On the wiring diagram, add choke L106 between terminal 8 of XV/101 and terminal 6 of XV/102.

Dated 24 March 1945

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NAVY DEPARTMENT

BUREAU OF SHIPS

WASHINGTON 25, D. C.

20 November 1944

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/s/ J. B. Dow

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RECORD OF CORRECTIONS MADE

Change No.	Date	Signature of Officer Making Correction

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GUARANTEE

The equipment including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such items found to be defective as to material, workmanship or manufacture will be repaired or replaced, f.o.b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government; provided that such guarantee will not obligate the Contractor to make repair or replacement of any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and the defect is not the result of normal expected shelf life deterioration.

To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten per cent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred per cent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for affecting expeditious adjustment under the provisions of this contractual guarantee.

The above one year period will not include any portion of time the equipment fails to perform satisfactorily due to any defects, and any items repaired or replaced by the Contractor will be guaranteed anew under this provision.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. Report component failures on card form NBS 383.

INSTALLATION RECORD

Contract Number NXsr 69266. Date of Contract, 17 August 1944

Serial Number of equipment.....

Date of acceptance by the Navy.....

Date of delivery to contract destination.....

Date of completion of installation.....

Date placed in service.....

Blank spaces on this page shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the date of acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

REPLACEMENT MATERIAL

All requests or requisitions for replacement material should include complete descriptive data covering the part desired, in the following form:

1. Name of part desired.
2. Federal Stock number (if assigned).
3. Navy Type number (if assigned) (including *prefix* and *suffix* as applicable.)
4. Commercial designation.
5. Model designation (including *suffix*) of equipment in which used.
6. Navy Type designation (including *prefix* and *suffix* where applicable) of major unit in which part is used.
7. Contract, purchase order, requisition, etc., under which equipment was procured.
8. Circuit symbol designation of part.
9. (a) Navy drawing and/or specification number. (Include part of group number.)
   (b) Manufacturer's drawing or specification's number. (Include part or group number.)

DESTRUCTION OF ABANDONED MATERIAL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment and when ordered to do so. DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED, OR USED BY THE ENEMY, BURN ALL PAPERS AND BOOKS.

Means:

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gaoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil, and water-cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.

DESTROY EVERYTHING

SAFETY NOTICE

THIS EQUIPMENT EMPLOYS VOLTAGES WHICH ARE DANGEROUS AND MAY BE FATAL IF CONTACTED BY OPERATING PERSONNEL. EXTREME CAUTION SHOULD BE EXERCISED WHEN WORKING WITH THE EQUIPMENT.

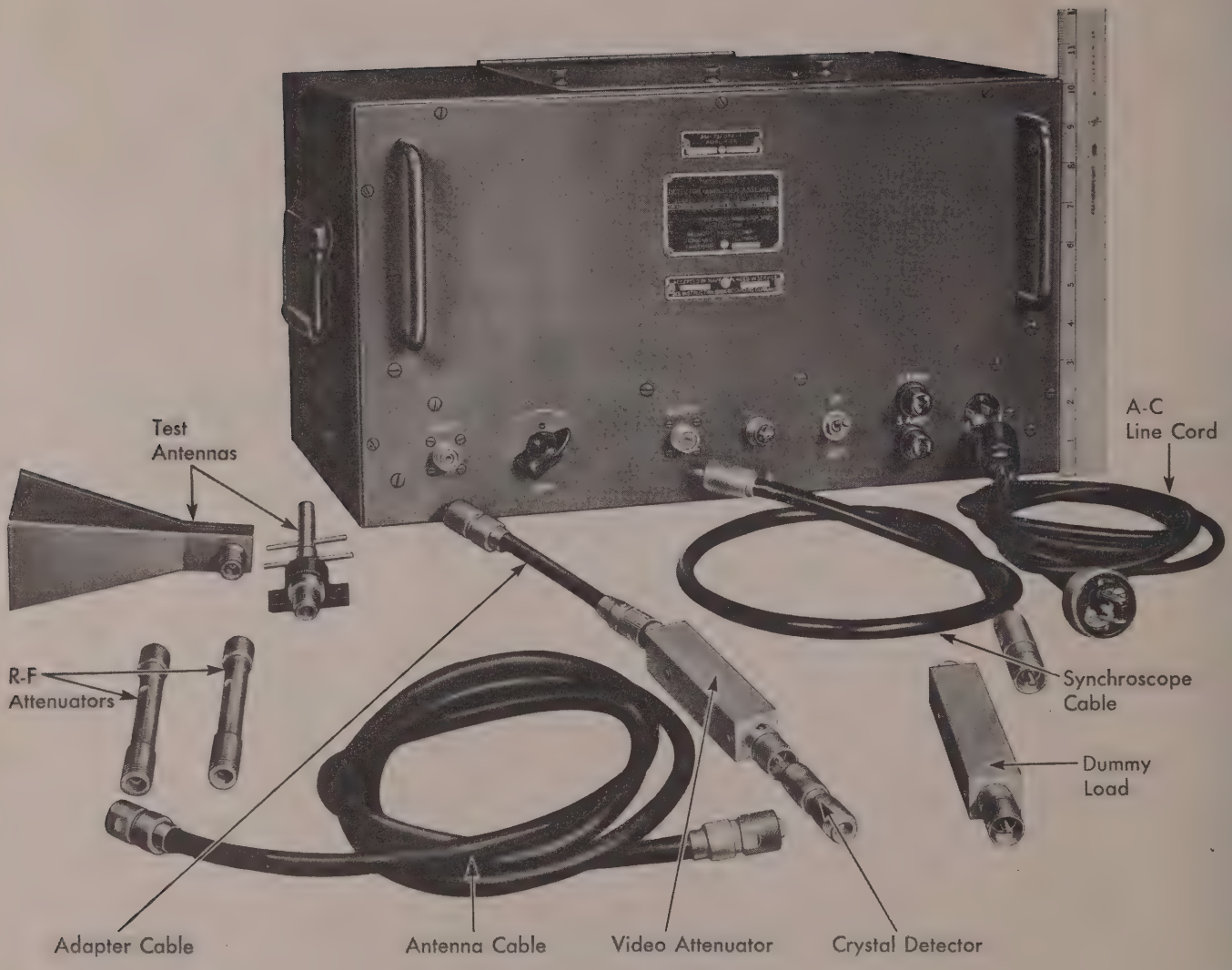


Figure 1-1—Detector Amplifier AN/UPA-1, Complete Equipment

SECTION I
GENERAL DESCRIPTION

1. MAJOR UNIT.

These instructions cover the installation, operation and maintenance of Detector Amplifier AN/UPA-1 and its associated equipment. Photographs, drawings and schematic diagrams of the entire equipment are provided together with instructions for the use of the equipment.

2. ELECTRICAL CIRCUITS.

Detector Amplifier AN/UPA-1 performs the functions that its name implies. It rectifies and amplifies without detecting, frequencies between 100 cps and 6 megacycles, and detects frequencies above 6 megacycles, amplifying the resultant "envelope", representing modulating frequencies from 100 cps to 6 megacycles. The output of the amplifier is applied to Synchroscope TS-28/UPN or to an ordinary oscilloscope. The equipment includes a crystal detector, the video amplifier, antennas for picking up r-f radiation, r-f attenuators to prevent overloading of the crystal detector, a video attenuator to prevent overloading the amplifier, and a dummy load for use between the detector amplifier and the Synchroscope or oscilloscope.

3. APPLICATION.

This equipment is intended as a means of examining the "envelope" of transmitted radar or other r-f signals. The video amplifier can be used independently of the detector to provide amplification of signals within its frequency range. As noted above, this is not in itself equipment for measuring or observation, but merely an auxiliary to other test equipment.

4. EQUIPMENT SUPPLIED.

The following equipment is supplied with Detector-Amplifier AN/UPA-1.

Quan. per Equipment	*Name of Unit*	*Navy Type Designation*	*Overall Dimensions in Inches*	*Weight in lbs.*	*Numerical Series of Ref. Symbols*
1	Video Amplifier	AM-73/UPA-1	18½ x 10¾ x 12	55	101-199
1	Crystal Detector Unit	CHS 1N23	⅝ x 1 x 1¾	.125	
1	"S" Band pickup antenna	AT-48/UP	2⅝ x 2 x 2½	.2	
1	"X" Band pickup antenna	AS-23/AP	2¼ x 3¾ x 1¼	.56	
1	R-F attenuator, 10 db.	TPS-51-PB/10	⅝ diam. x 5	.25	
1	R-F attenuator, 20 db.	TPS-51-PB/20	⅝ diam. x 5	.25	
1	Video Attenuator	CN-25/UPA-1	5⅛ x 1 x 1	.28	
1	Dummy Load	TS-288/UPA-1	5⅛ x 1 x 1	.27	
1	Antenna Cable		6′ RG-9/U, two plugs #49284	.75	
1	Adapter Cable		6″ RG-9/U, plugs #49284 and #49195	.22	
1	Synchroscope Cable		36″ RG-63/U, plugs mod. #49190 and #49195	.53	
1	A-C line cord			.5	
			Overall crated dimensions: 19½ x 26½ x 23	Overall crated weight: 109 lbs.	

5. AUXILIARY EQUIPMENT.

The Detector Amplifier is intended especially for use with Synchroscope TS-28/UPN, and its characteristics are designed for operation with that equipment. For use of the Synchroscope, see Instruction Book for Navy Model TS-28/UPN, Synchroscope.

a. TUBE COMPLEMENT.

Quantity	*Type*	*Designation*	*Function*
1	JAN 6AC7	V101	Video Amplifier
1	JAN 6AC7	V102	Video Amplifier
1	JAN 6AC7	V103	Video Amplifier
1	JAN 6AG7	V104	Cathode follower output
1	JAN VR105	V105	Voltage regulator
1	JAN 5Y3GT	V106	Full wave rectifier

b. POWER SUPPLY ..... 105 to 125 volts
50 to 70 cps.
53.5 watts at 117.5 volts

c. FREQUENCY RANGE 100 cps to 6 mc.

d. PERTINENT CONTRACTUAL DATA.

(1) This equipment is manufactured under Navy Contract NXsr 69266, dated 17 August 1944.

(2) The cognizant Naval Inspector is Captain Wm. E Malloy, U.S.N., Inspector of Naval Materials, Chicago, Illinois.

Figure 2-1—Amplifier AM-73/UPA-1, Front Panel

SECTION II
OPERATION AND ADJUSTMENT

1. INSTALLATION.

a. Since the Detector Amplifier is test equipment, no special provisions need be made for mounting it, nor are installation instructions required.

b. Should it be desired to place the equipment permanently, fig. 2-3 shows outline and mounting dimensions.

c. Cables are furnished assembled with connectors. For cable repair or renewal, see fig. 2-2 for instructions as to the attachment of connectors.

2. ADJUSTMENTS.

a. The equipment requires no preliminary adjustments other than a routine check to see that tubes are firmly fixed in their sockets and that Lamp I101 and fuses F101 and F102 are in order. Any further adjustments are concerned with the operation of the equipment, and will be discussed in paragraph 3.

b. PERFORMANCE TEST. It may be advisable to make a brief check on the performance of the equipment. To do this, a modulated r-f signal generator of 50 ohms output impedance and Synchroscope TS-28/UPN or an oscilloscope are necessary.

(1) Connect the female connector of the a-c line cord to the receptacle on the front panel (fig. 2-1). Attach the line cord to a 115 volt 50-70 cps power source. (See fig. 2-4.)

(2) Attach the crystal detector to the adapter cable, and the cable, in turn to the "INPUT" receptacle on the front panel.

(3) Connect the antenna cable to the detector housing and to the signal generator.

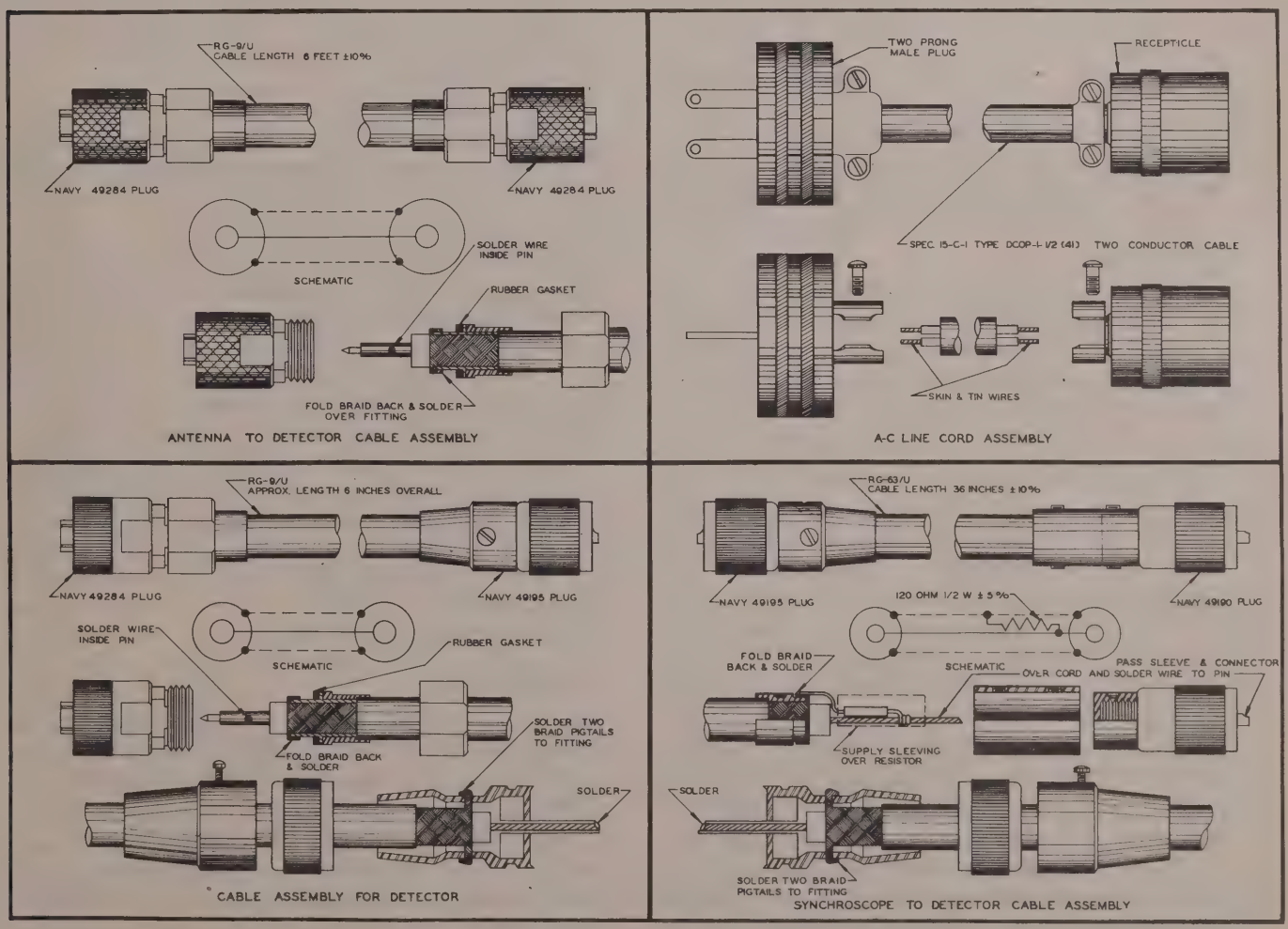


Figure 2-2—Attaching Connectors to Cables

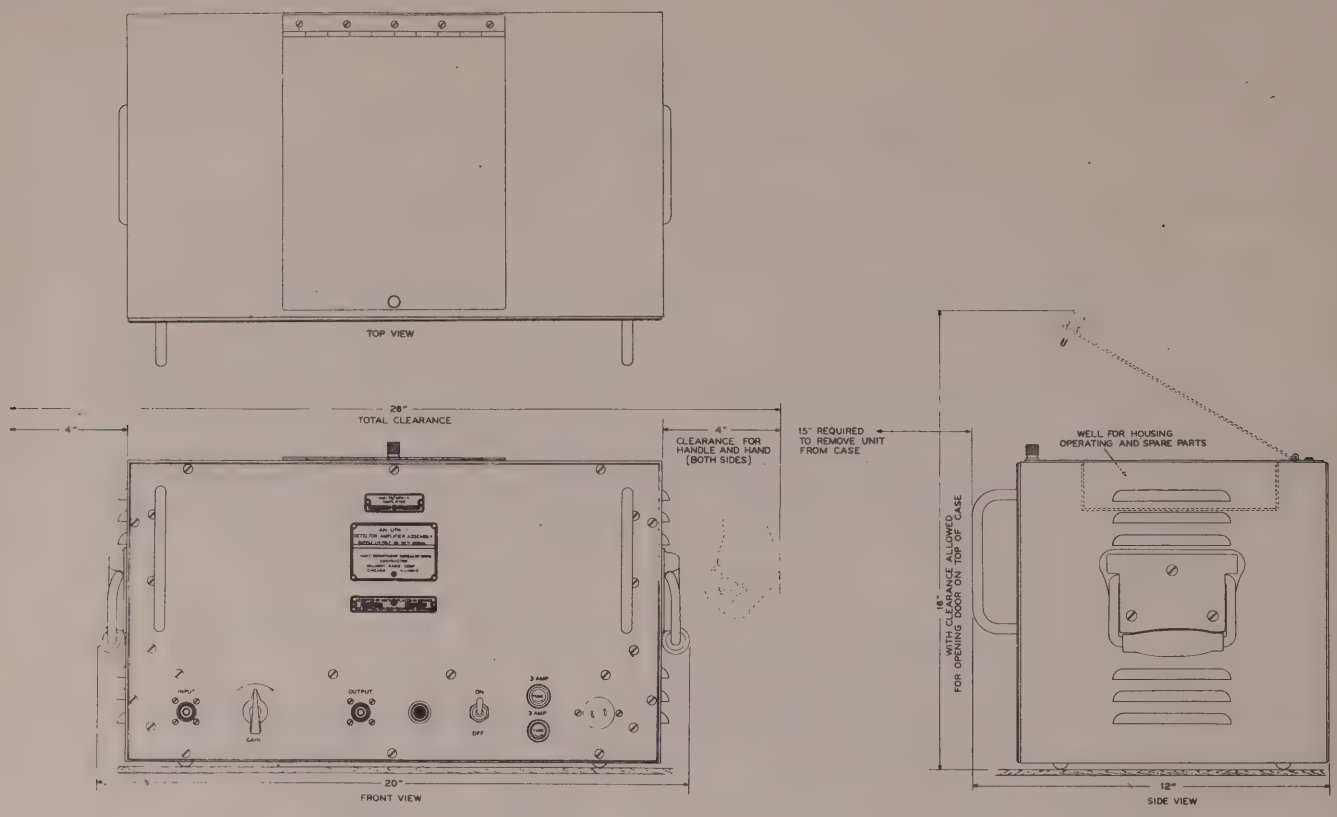


Figure 2-3—Dimensional Installation Drawing

(4) Connect the synchroscope cable to the "OUTPUT" receptacle on the front panel of the amplifier and to the "SIGNAL IN" receptacle on the front panel of the Synchroscope or the input terminals of the oscilloscope.

(5) Turn the "ON-OFF" switch on the front panel of the amplifier to "ON." Apply power to the signal generator and to the Synchroscope or oscilloscope. Turn the gain or output control of the generator to a minimum and do likewise with the "OUTPUT" control on the front panel of the amplifier.

(6) To test the gain of the amplifier, remove the detector from the circuit, and set the signal generator to any frequency between 100 cps and 6 megacycles. Set the sweep frequency of the oscilloscope to a range encompassing that frequency, and adjust the fine sweep control so that the pattern is stationary. The pattern should correspond to the output of the signal generator, and can be checked by connecting the signal generator directly to the oscilloscope. The amplitude of the amplified pattern should vary in a linear manner as the "OUTPUT" control on the amplifier is rotated. In this test, and in the one below, it may be necessary to increase the output of the generator above its minimum. Repeat this test at several frequencies within the 100 cps-6 megacycle range. The amplifier should show nearly uniform response to any frequency within these limits, provided the input voltage is constant.

(7) To test the detector action of the equipment insert the detector in the circuit and repeat the above test, setting the signal generator to any frequency above 6 megacycles. In this instance, the sweep frequency of the oscilloscope should correspond to the modulating frequency at the signal generator, and the pattern seen on the screen will represent the modulating frequency, and should correspond without distortion to the shape of that wave; sinusoidal, pulse, square wave, etc. This pattern should again vary in amplitude directly with changes of the "OUTPUT" control of the amplifier. If any of these conditions is not fulfilled, refer to Section IV, MAINTENANCE, for instructions as to the correction of troubles.

(8) Turn the "ON-OFF" switch on the front panel of the amplifier to "OFF," remove power from the signal generator and the oscilloscope.

3. OPERATION.

a. Since the detector amplifier can be used in the testing of many types of equipment, only general instructions as to its use can be given. Two precautions must be observed, the avoidance of over-driving the detector, and the avoidance of overdriving the amplifier. Failure to observe the first precaution may damage the crystal detector. Overdriving in either instance will result in the distortion of the waveforms under observation. See fig. 2-4.

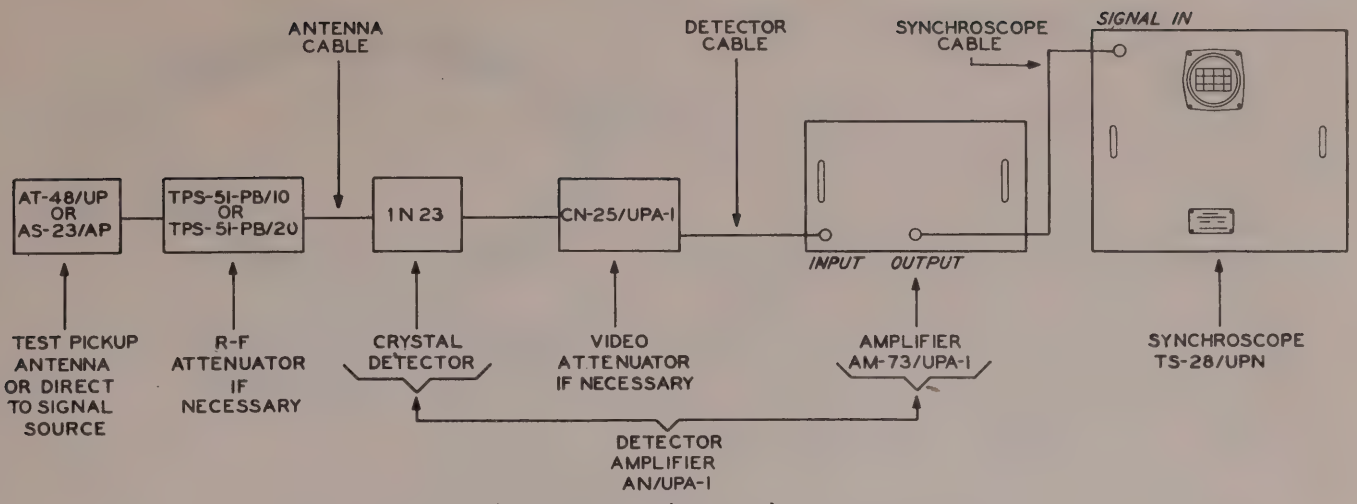


Figure 2-4—Detector Amplifier AN/UPA-1, Connections for Operation

CAUTION

In every instance, before applying any voltage to the crystal detector, determine whether the power is below 1.25 milliwatts, across 50 ohms, since any greater amount of power applied to the crystal will damage it irreparably. If too much power is present, see paragraph 3e below.

b. THE CRYSTAL DETECTOR. The crystal detector is a replaceable unit, housed in a metal enclosure. The detector rectifies the r-f voltage applied to it. It is a very delicate unit (see caution note above). When the signal being examined is a modulated r-f voltage, the crystal is connected to the "INPUT" receptacle on the front panel (fig. 2-1) of the amplifier by means of the adapter cable. The antenna cable, in turn, is connected to the crystal detector housing.

c. THE ANTENNAS. "S" band and "X" band pickup antennas (fig. 2-5) are furnished for observing radiated r-f voltages. Either of these antennas, depending on the frequency of the equipment under test, is attached to the antenna cable. In placing the pickup antenna near the source of radiation, keep the antenna at a distance from this source depending upon the power being radiated, to avoid overdriving the crystal detector. If it should be necessary to use the antenna quite near to a large source of radiation, the use of an r-f attenuator is advisable.

d. DIRECT CONNECTION. If output receptacles on the equipment being tested are available, and are of the size and type to fit the connector on the antenna cable, this cable may be connected directly. Before making this connection, determine the output impedance at the receptacle on the equipment being tested and the average output power at this receptacle. If the average power output is greater than 1.25 milliwatts across 50 ohms, use one of the r-f attenuators as indicated in paragraph 3e below.

e. THE R-F ATTENUATORS. Two r-f attenuators are furnished with the equipment. If the output power of the equipment under test is greater than 1.25 milliwatts across 50 ohms, or if there is any doubt about the power, insert the r-f attenuator marked 20 db., (see fig. 2-5) which will attenuate the signal by that amount. If it is found that the signal as seen on the oscilloscope is small in amplitude, change to the attenuator marked 10 db for less attenuation. If the amplitude is still not sufficient, and the amplifier is operating at full gain, it will be safe to use the equipment without r-f attenuation.

f. Should the signal be so strong as to overdrive the amplifier, attach the Video Attenuator between the amplifier and the detector (fig. 2-4). The video attenuator reduces the amplitude of the input voltage to the amplifier, and has frequency compensation so that the waveform is unaffected.

g. CONNECTION TO SYNCHROSCOPE TS-28/UPN. The synchroscope cable is terminated in a resistance of 120 ohms. Connect this cable to the "OUTPUT" receptacle on the front panel of the amplifier, and to the "SIGNAL IN" receptacle on the front panel of the Synchroscope. See the Instruction Book for Navy Model TS-28/UPN, Synchroscope, for operation of that equipment. In connecting the synchroscope cable, it is essential that the end of the cable containing the terminating impedance be connected at the Synchroscope. This end is marked "120 ohms" and can be identified readily since a $\frac{3}{4}$" sleeve containing the impedance extends $1\frac{3}{16}$" back from the connector on that end of the cable. (See fig. 2-6.)

(1) Should some cable other than the Synchroscope cable be connected to the Synchroscope, use the dummy load at the "SIGNAL IN" receptacle of the

Synchroscope. This will provide the proper terminating impedance in place of that built into the regular Synchroscope cable.

h. CONNECTION TO AN OSCILLOSCOPE. If the detector amplifier is used in conjunction with an oscilloscope, standard practice can be followed.

i. TO START THE EQUIPMENT. To start the equipment, turn the "ON-OFF" switch on the front panel of the amplifier (fig. 2-1) to "ON." The "OUTPUT" control on the front panel is the only control used in the operation of the equipment. This controls the amount of amplification of the unit.

j. TO STOP THE EQUIPMENT. To stop the equipment, throw the "ON-OFF" switch on the front panel of the amplifier to "OFF."

Figure 2-6—Synchroscope Cable and Dummy Load

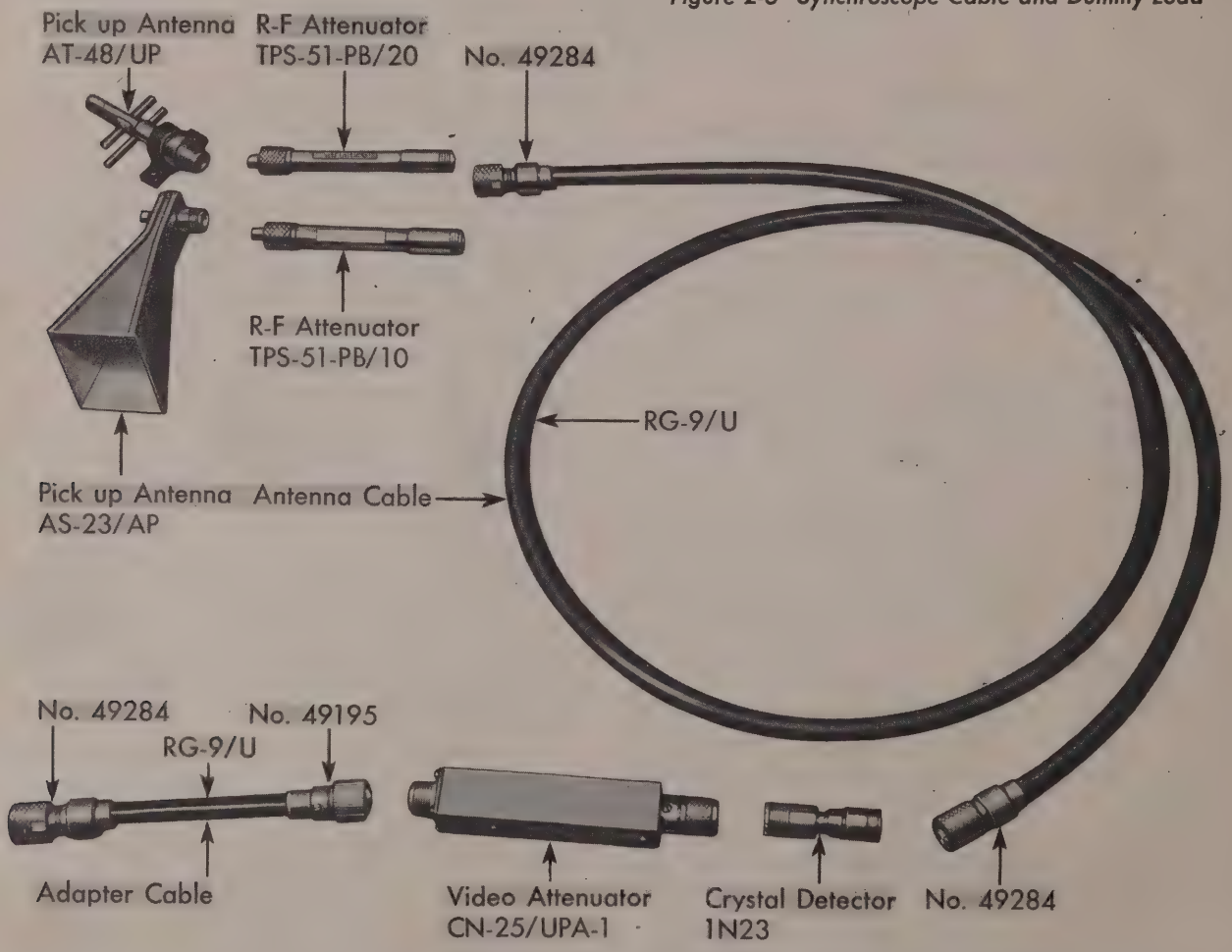


Figure 2-5—Crystal Detector, Adapter Cable, Video Attenuator, Antenna Cable, R-F Attenuators, and Pickup Antennas

SECTION III
THEORY OF OPERATION

1. GENERAL.

a. Detector Amplifier AN/UPA-1 is intended for use with the oscilloscope section of Synchroscope TS-28/-UPN, though it can be used with ordinary oscilloscopes. By means of it, frequencies, including short r-f pulses, can be detected and then amplified for viewing on the oscilloscope screen. The signal is first detected, producing a waveform which corresponds to the variations in the r-f amplitude of the signal voltage. This waveform follows the peaks of the signal and may be looked upon as an "envelope."

b. A schematic diagram of the amplifier is shown in figure 3-1. It is a four stage video amplifier consisting of three pentode video amplifier tubes, resistance coupled in cascade, feeding a cathode follower output stage. A gas tube stabilizes the screen supply voltage. The unit incorporates its own power supply, consisting of transformer, full-wave rectifier, and ample filtering.

c. The crystal, to which the voltage under test is applied, is a type 1N23 high frequency detector crystal. Functionally it may be regarded as a rectifier since it has the property of passing current in one direction only.

d. The rectified r-f voltage from the crystal is applied across resistor R101 and coupled to capacitors C100 and C101 to the control grid of the first pentode tube, V101, a JAN 6AC7, by a resistive network consisting of R102, R105 and a variable resistor, R106. Degenerative feedback between grid and cathode is afforded by the un-bypassed cathode resistors; the amount of this feedback is controlled by variable resistor R106, which serves consequently as the "OUTPUT" control of the amplifier.

e. The plate circuit load of V101 is made up of choke coil L101, and plate resistor R104. These elements form a frequency compensating network to provide substantially equal response to all frequencies throughout the range. R103 is a dropping resistor, and C102 is a bypass capacitor. Identical networks are employed in the plate circuits of V102 and V103.

f. Voltage is supplied to the screen grids of V101, V102, and V103 through dropping resistors R112, R113, and R114. Capacitor C107 is the screen bypass capacitor. Tube V105, a VR-105, which is characterized by a constant voltage drop in spite of current fluctuations, is used to stabilize the screen voltage. This improves the stability of the amplifier by holding the transconductance of the tubes more nearly constant. R107 supplies some fixed bias for V101, using the stabilized voltage provided by the screen supply.

g. The output of V101 is coupled from the plate of the tube through coupling capacitor C103 to the control grid of V102 across grid resistor R108. Similarly, the output of V102 is coupled by capacitor C105 to the grid of V103 across resistor R115. The output of V103 is coupled to the grid of V104, a 6AG7 r-f power pentode, through capacitor C108 across grid resistor R119.

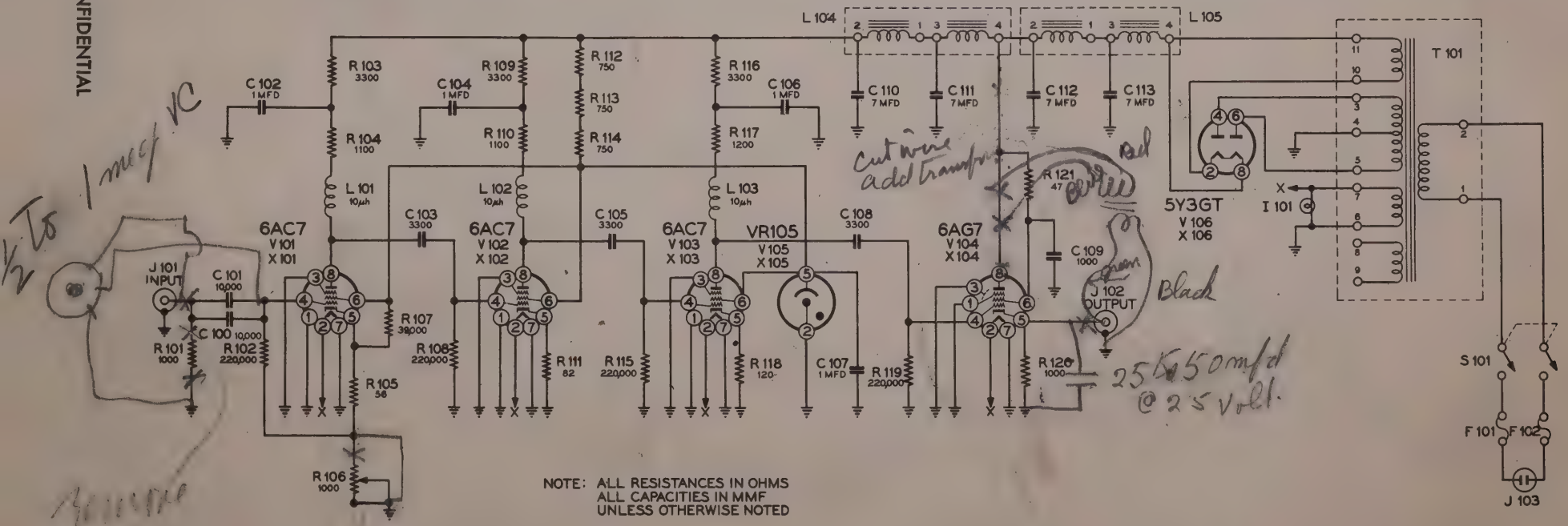
h. Negative feedback, preventing over-amplification and providing increased stability of output, is obtained in all three stages by means of cathode resistors without bypass capacitors.

i. Tube V104 functions as a cathode follower. It is used in order to obtain a very low impedance source to feed the cable to the Synchroscope. The output of the tube is taken across cathode resistor R120, and is connected directly to the "OUTPUT" receptacle, J102, on the front panel. The plate of V104 is connected directly to a point on the high voltage supply filter which supplies it with 200 volts. No plate resistor is employed since no output is taken from the plate circuit. R121 is the screen dropping resistor and C109 the screen by-pass capacitor.

j. V106, a 5Y3GT, is a full wave rectifier tube. Transformer T101 provides high voltage for this tube from a center-tapped secondary winding. Other secondaries supply, respectively, 5 volts for the filament of V106, 6.3 volts for the filaments of the other tubes and for lamp I101, and an auxiliary winding providing 6.3 volts as an emergency filament winding. "ON-OFF" switch S101 and fuses F101 and F102 (fig. 3-1) are connected in the primary circuit of the transformer.

SCHEMATIC LEGEND FOR AMPLIFIER AM-73 UPA-1

CAPACITORS				RESISTORS				RESISTORS (cont'd)				MISCELLANEOUS	
Symbol	*Value MMF*	*Tol. ± %*	*VDCW*	*Symbol*	*Value*	*Tol. ± %*	*Watts*	*Symbol*	*Value*	*Tol. ± %*	*Watts*	*Symbol*	*Description*
C100	10,000	10	300	R101	1,000	10	½	R111	82	10	½	F101	Fuse, 2 amp. 250 volt.
C101	10,000	10	300	R102	220,000	10	½	R112	750	10	2	F102	Fuse, 2 amp. 250 volt.
C102	1 MF	20	400	R103	3,300	10	2	R113	750	10	2	I101	Lamp, pilot, 6.3 volt.
C103	3,300	10	500	R104	1,100	10	½	R114	750	10	2	J101	Connector, coax., female.
C104	1 MF	20	400	R105	56	10	½	R115	220,000	10	½	J102	Connector, coax., female.
C105	3,300	10	500	R106	1,000	(Var.)	2	R116	3,300	10	2	J103	Receptacle, a-c, male.
C106	1 MF	20	400	R107	39,000	10	½	R117	1,200	10	½	L101	Radio Frequency Choke.
C107	1 MF	20	400	R108	220,000	10	½	R118	120	10	½	L102	Radio Frequency Choke.
C108	3,300	10	500	R109	3,300	10	2	R119	220,000	10	½	L103	Radio Frequency Choke.
C109	1,000	10	500	R110	1,100	10	½	R120	1,000	10	½	L104	Dual Filter Choke.
C110	7 MF	+20—10	600					R121	47	10	½	L105	Dual Filter Choke.
C111	7 MF	+20—10	600									S101	Switch, toggle, d.p.s.t.
C112	7 MF	+20—10	600									T101	Transformer, power.
C113	7 MF	+20—10	600									X101—6	Socket, tube, 8 pin, octal.



NOTE: ALL RESISTANCES IN OHMS
ALL CAPACITIES IN MMF
UNLESS OTHERWISE NOTED

Figure 3-1—Amplifier AM-73/UPA-1, Schematic Diagram

Hookup change.

V Control - 25
transformer 69
condenser 31
125

SECTION IV
MAINTENANCE

WARNING

Service of this equipment involves the use of high voltages which may be dangerous to life. Operating personnel must at all times observe safety regulations. Do not change tubes or make adjustments in the equipment while there is power applied to it.

1. PREVENTIVE MAINTENANCE.

a. While this equipment is intended for test purposes only, preventive maintenance is advisable so that it will be in good operating condition to meet any emergency.

b. A periodic check should be made of the six tubes in the amplifier.

c. At the same time that this check is made, all circuit elements should be examined carefully and contacts checked and cleaned.

d. The cables and their connectors should be examined thoroughly to see that connections are good and that insulation is intact. Contacts in the connectors should be kept clean.

IMPORTANT

Since high frequencies are present in this equipment, the physical position of circuit elements is of great importance. Note particularly that r-f chokes L101, L102, and L103 are mounted to keep them at a maximum distance from other elements. Do not bend their leads so that these chokes might be closer to other parts.

2. TROUBLE ANALYSIS.

a. GENERAL. The equipment may be divided into three sections as to the location of trouble. These are: accessories, such as cables, video attenuator, and connectors; the crystal detector; the video amplifier.

b. ACCESSORIES. Since r-f voltages are involved, it is important that all connections be secure, and connectors and receptacles fit firmly together. Poor connections may result in a weak signal at the oscilloscope, in an unstable pattern on the screen, or in spurious patterns. Figure 2-2 shows dimensions to be followed in attaching connectors to the cables. These dimensions must be followed accurately.

c. THE CRYSTAL DETECTOR. Failure of the crystal detector usually results in its having little resistance rather than in its being open. As a result, the pattern seen on the screen of the oscilloscope at frequencies below 6 megacycles will represent the entire wave from the signal applied, or from the signal generator. Above 6 megacycles, detection will not take place and no pattern, or a pattern that is barely discernible, will appear on the screen. The crystal detector is enclosed in a small cartridge in a housing, and may be removed readily by unscrewing the two parts of the housing.

d. THE VIDEO AMPLIFIER. Complete failure of the video amplifier will result in no pattern being seen on the screen of the oscilloscope. Partial failure may be indicated by: small amplitude of the pattern, representing a loss in gain; distortion of the pattern, representing distortion in the amplifier; uneven response over the 100 cps-6 mc range; intermittent response; other phenomena caused by the high frequencies involved. The procedure outlined below should show up any troubles in the amplifier.

3. AMPLIFIER MAINTENANCE.

a. Figs. 4-3 and 4-4, below, show resistances and voltages to ground at the various tube sockets. Before any other steps are taken, tubes should be tested either on a tube tester or by replacement, and voltage and resistance readings should be taken. These tests should reveal any obvious faults at once.

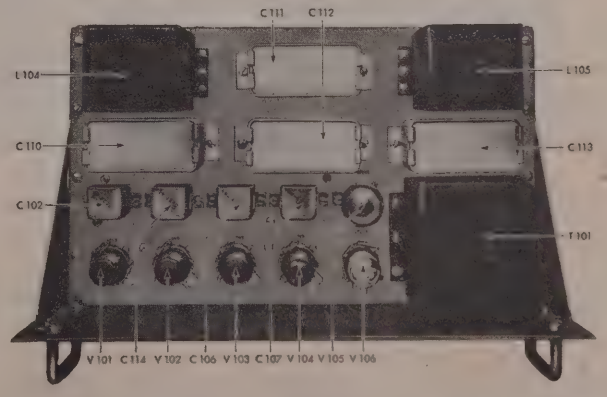


Figure 4-1—Amplifier AM-73/UPA-1, Top View of Chassis

NOTICE

All tubes of a given type supplied with equipment should be used prior to employment of tubes from general stock.

b. In the case of lack of uniform frequency response, check V105, the VR105, carefully, or replace it, and examine the screen voltage supply circuit carefully, since screen voltage stability is highly important to frequency stability in the amplifier.

c. Frequency response may be affected, or distorted patterns be seen as a result of stray capacities in the unit at the frequencies involved. If these faults occur, examine the elements of the circuit and the wiring carefully. See "IMPORTANT" notice, paragraph 1, as to the position of the plate circuit chokes. Check to see that lead wires are separated where possible, and that all insulation is intact.

d. In the event that these procedures have failed to locate the trouble, signal tracing methods may be used. Connect a signal generator having an output impedance of 50 ohms to the "INPUT" receptacle on the front panel of the amplifier. Setting the generator at various frequencies between 100 cps and 6 mc, trace the signal through V101, V102, and V103, using an oscilloscope of high input impedance, set with the sweep frequency at the proper range for the signal frequency. Note the gain through each stage with the "OUTPUT" control set near maximum, and watch for distortion in any stage. The output from the cathode follower stage, V104, should be observed with an instrument having low input impedance, or through the "SIGNAL IN" receptacle on Synchroscope TS-28/UPN. Trace the signal through the amplifier at several frequencies within the above range, noting particularly the response at the high and low ends of the band.

e. Some of the illustrations in Section V may be of help in servicing the equipment. In particular, fig. 5-5 gives data concerning the power transformer, and fig. 5-6 regarding the filter chokes. Note the additional filament winding provided on the power transformer.

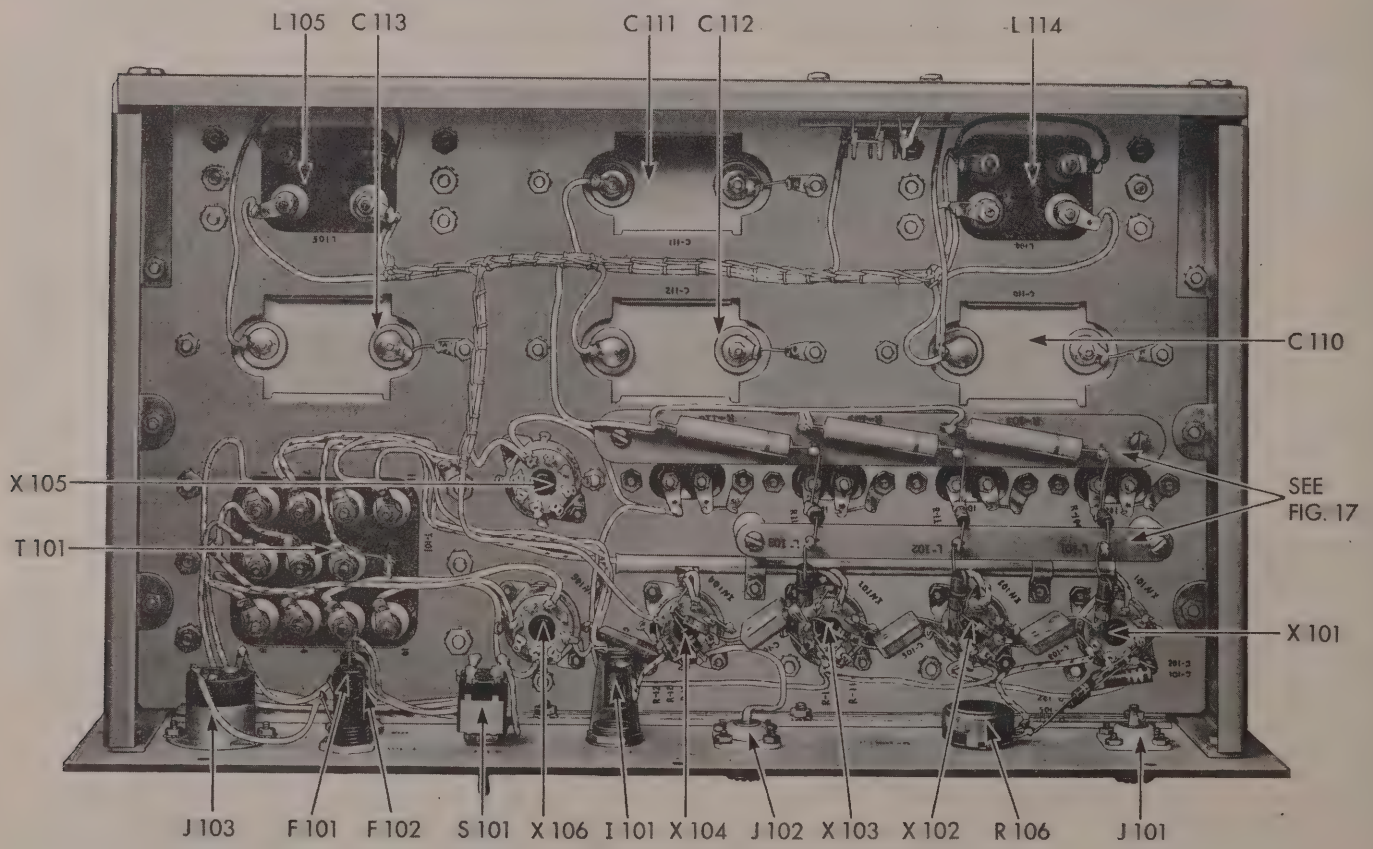


Figure 4-2—Amplifier AM-73/UPA-1, Bottom View of Chassis

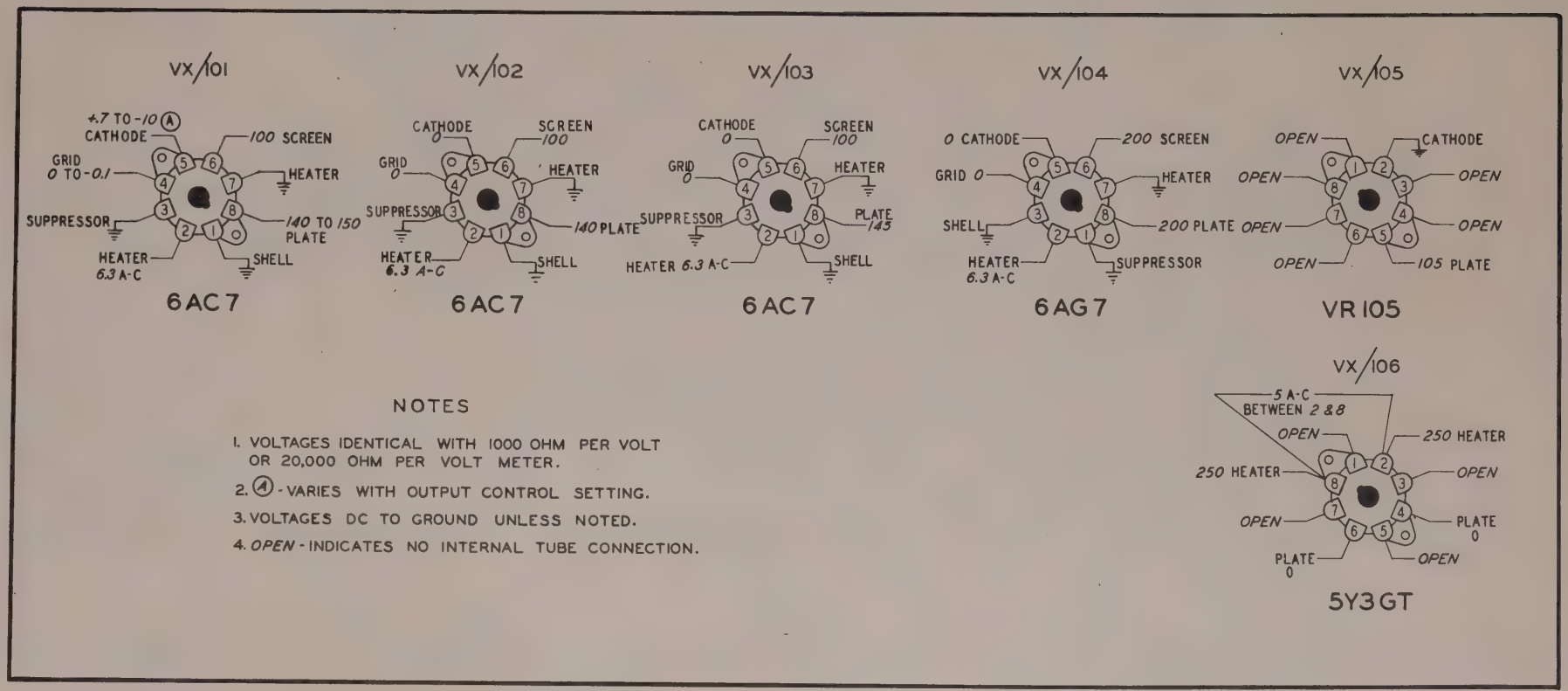


Figure 4-3—Tube Socket Voltages

Figure 4-3—Tube Socket Voltages

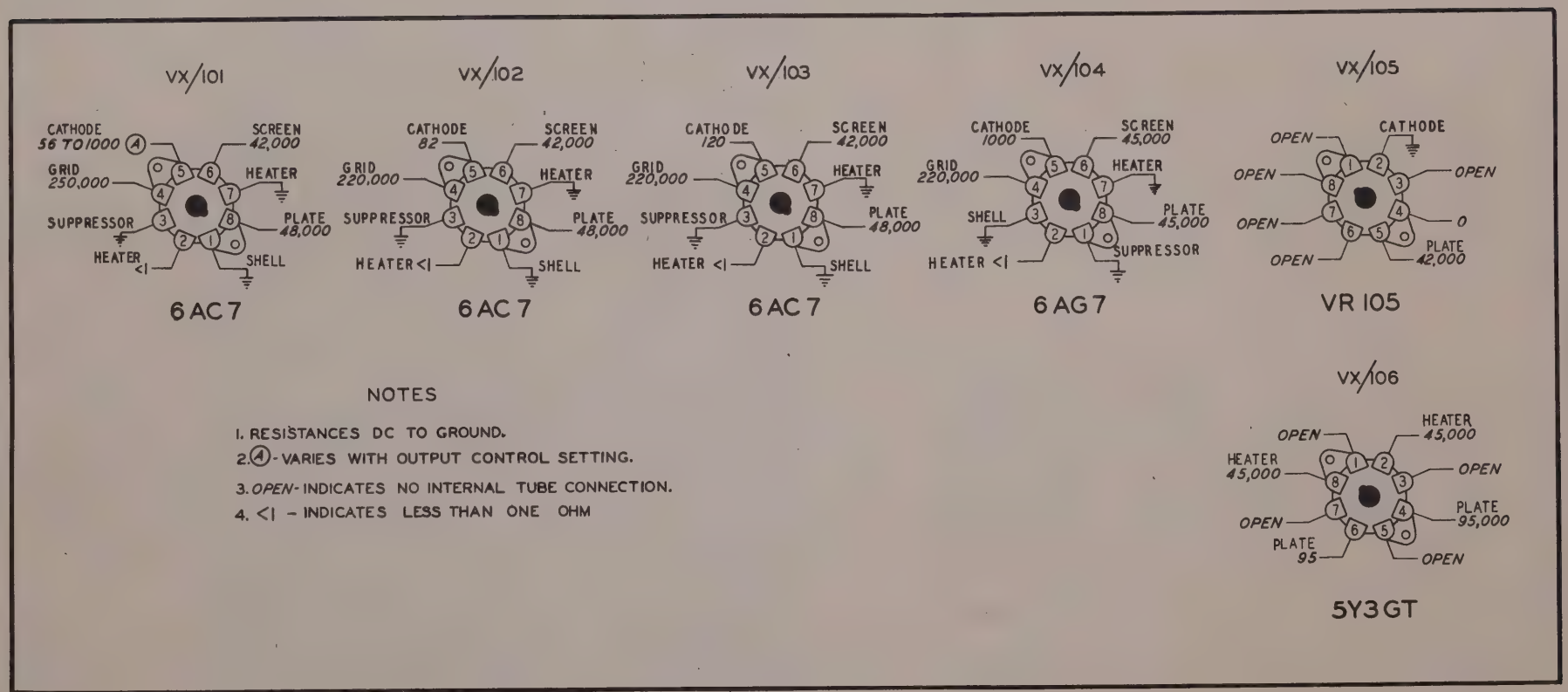


Figure 4-4—Tube Socket Resistances to Ground

Figure 4-4—Tube Socket Resistances to Ground

CONFIDENTIAL

SECTION V
SUPPLEMENTARY DATA

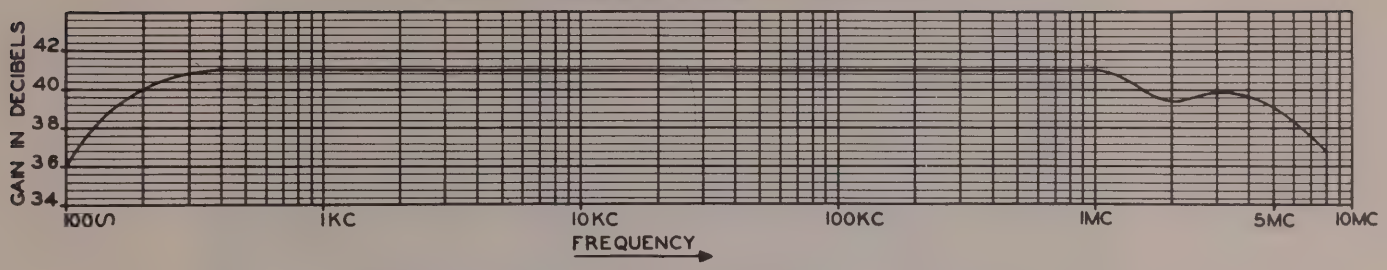
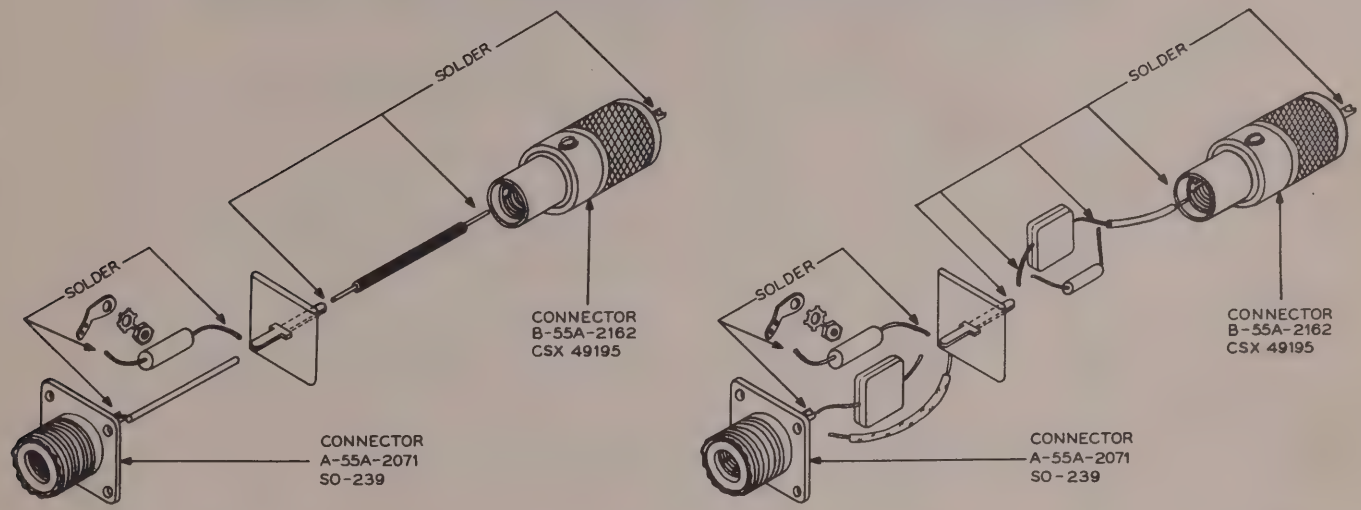


Figure 5-1—Amplifier AM-73/UPA-1, Average Frequency Response Curve



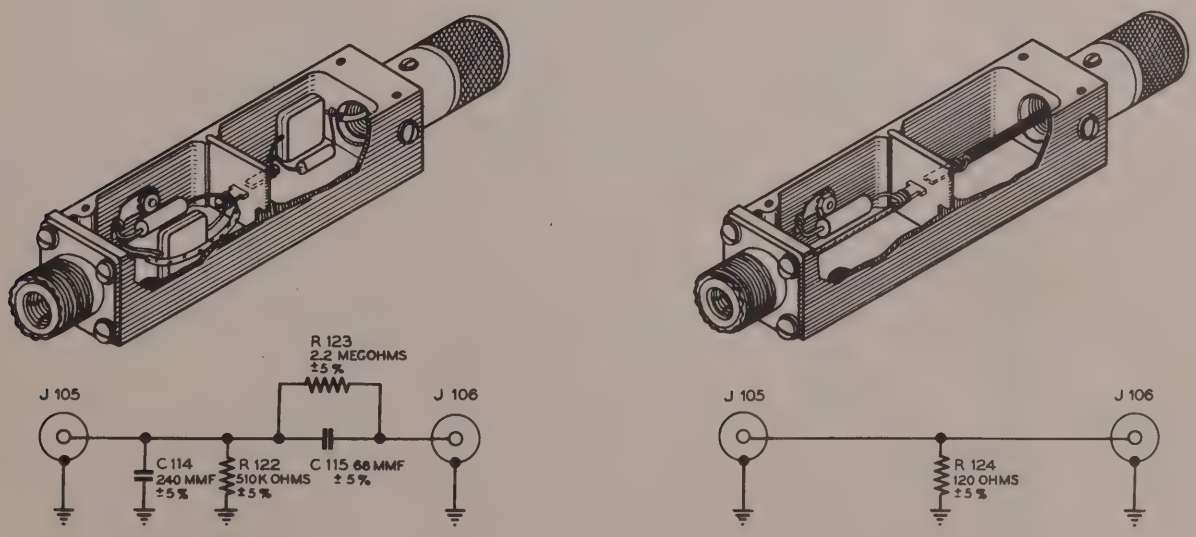


Figure 5-2—Video Attenuator and Dummy Load

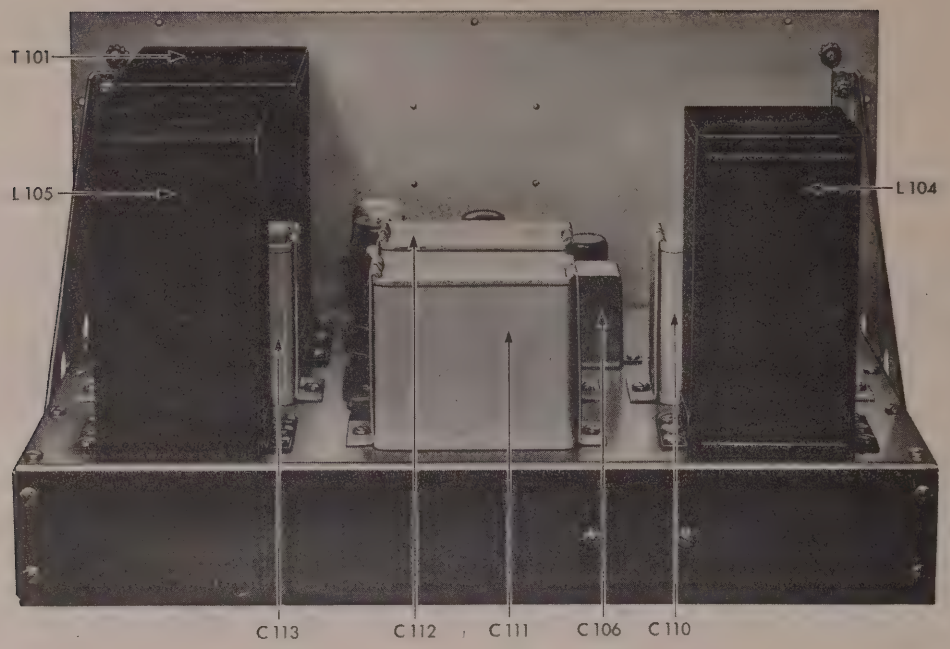


Figure 5-3—Amplifier AM-73/UPA-1, Rear View of Chassis

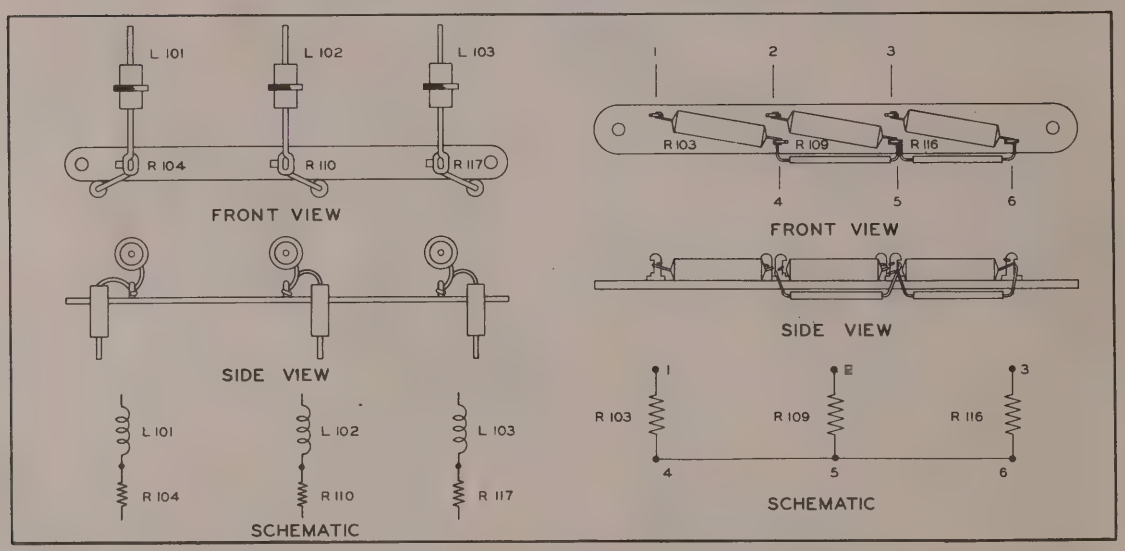


Figure 5-4—Terminal Boards

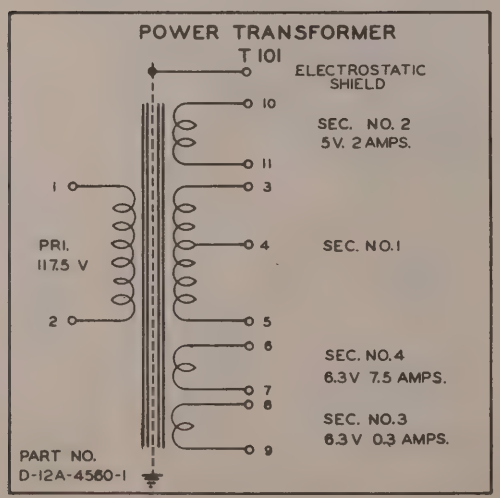


Figure 5-5—Power Transformer, T101

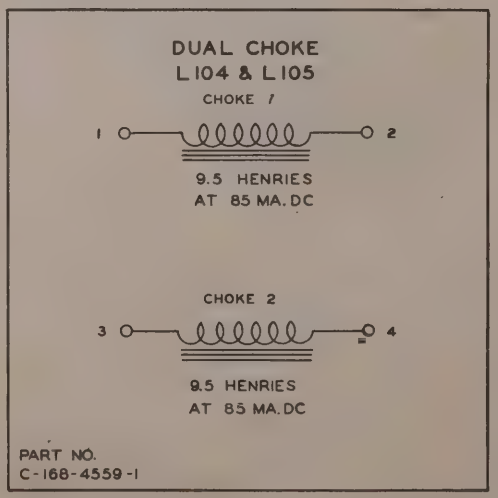
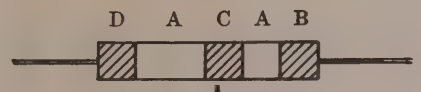


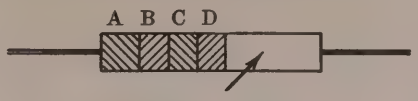
Figure 5-6—Filter Chokes, L104 and L105

SECTION VI
TABLE OF REPLACEABLE PARTS

RMA COLOR CODES FOR RESISTORS (OHMS)



BAND OR DOT
OLD COLOR ARRANGEMENT



BODY COLOR
NEW COLOR ARRANGEMENT

Body color (new color arrangement only) indicates type of resistor, as follows:

Black—Composition, non-insulated.

Tan, Olive or White—Composition, insulated.

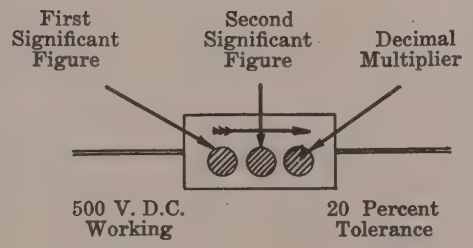
Dark Brown—Wire-wound, insulated.

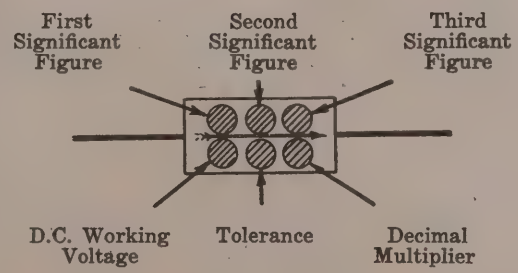
COLOR	A 1st Digit	B 2nd Digit	C Multiplier
Silver			0.01
Gold			0.1
Black		0	1.0
Brown	1	1	10
Red	2	2	100
Orange	3	3	1,000
Yellow	4	4	10,000
Green	5	5	100,000
Blue	6	6	1,000,000
Purple	7	7	10,000,000
Gray	8	8	100,000,000
White	9	9	

D—Tolerance Code:

Gold—5% Silver—10% No Color—20%

RMA COLOR CODES FOR CAPACITORS (MMF)





Color	Numeral	Volts	Multiplier	Total
Black	0		1	
Brown	1	100	10	1%
Red	2	200	100	2%
Orange	3	300	1,000	3%
Yellow	4	400	10,000	4%
Green	5	500	100,000	5%
Blue	6	600	1,000,000	6%
Violet	7	700	10,000,000	7%
Grey	8	800	100,000,000	8%
White	9	900	1,000,000,000	9%
Gold		1,000	0.1	5%
Silver		2,000	0.01	10%
No Color		500		20%

Figure 6-1—Resistor and Capacitor Color Codes

MODEL: Detector Amplifier AN/UPA-1 **MAJOR ASSEMBLY: Amplifier AM-73/UPA-1**

Ref. Symbol	*Army Stock No. Navy Type No. British Ref. No.*	*Name of Part and Description*	*Function*	*Manufacturer and Designation*	*Drawing Number*	*Quantity per Major Unit*	*Quantity in Equip. Spares*	*Quantity in Stock Spares*
C-100	CM40B103K	CAPACITOR: Fixed; mica, 10,000 mmf; ±10%; 300 V.D.C.W; molded bakelite case.	Coupling to V-101	Micamold Type R	B-8F-506	2	1	2
C-101		See C-100.	Coupling to V-101					
C-102		CAPACITOR: Fixed; oil; 1 mfd; ±20%; 400 V.D.C.W;	Plate bypass V-101	Condenser Corp.	A-8B-6222	4	4	10
C-103	CM30B332K	CAPACITOR: Fixed; mica, 3300 mmf; ±10%; 500 V.D.C.W; molded bakelite case.	Coupling to V-102	Micamold Type W	B-8F-6177	3	1	3
C-104		See C-102.	Plate bypass V-102					
C-105		See C-103.	Coupling to V-103					
C-106		See C-102.	Plate bypass V-103					
C-107		See C-102.	Screen bypass V-101, V-102, V-103					
C-108		See C-103.	Coupling to V-104					
C-109	CM30B102K	CAPACITOR: Fixed; mica, 1000 mmf; ±10%; 500 V.D.C.W; molded bakelite case.	Screen bypass V-104	Micamold Type W	B-8F-985	1	1	1
C-110		CAPACITOR: Fixed; paper; 7.0 mfd; +20% −10%; 600 V.D.C.W; metal case, oil filled	Power supply filter	Condenser Corp.	B-8C-6684	4	4	10
C-111		See C-110.	Power supply filter.					
C-112		See C-110.	Power supply filter					
C-113		See C-110.	Power supply filter					
C-114	CM20B241J	CAPACITOR: Fixed; mica, 240 mmf; ±5%; 500 V.D.C.W; molded bakelite case.	Frequency compensation video attenuator	Micamold Type OXM	B-8F-6314	1	1	1
C-115	CM20B680J	CAPACITOR: Fixed; mica, 68 mmf; ±5%; 500 V. D.C.W; molded bakelite case.	Frequency compensation video attenuator.	Micamold Type OXM	B-8F-6315	1	1	1
E-101	AS-23/AP	ANTENNA: Pick-up; "X" band R-F antenna, for test purposes.	Test antenna		B-55N-6915	1		2
E-102	AT-48/UP	ANTENNA: Pick-up; "S" band R-F antenna, for test purposes.	Test antenna		B-55N-6916	1		2
E-103		HOUSING: For crystal detector; Navy Radiation Laboratory Type C-2456-A.	Hold crystal detector	Baynes	B-55A-6471	1	1	2
E-104		HOLDER: Fuse, black phenolic plastic; receptacle to accommodate type 4AG fuse.	Fuse holder	Buss Type HCM	A-55A-4623	2	1	2
E-105	CDP-61167	INSULATOR: Standoff; ultra steatite; glazed surface.	Insulator	Genceraco	A-5F-1120	2		2

E-106	CDP-61488	INSULATOR: Standoff; ultra steatite; glazed surface.	Insulator	Genceraco	A-5F-6193	2		2
E-107		KNOB: Control; bakelite; black.	Output control	Kurz-Kasch Type S-246-3L	A-5B-6020	1		1
E-108		GLYPTOL: Purple; 2 oz. bottle.		GE		As Req.		1
E-109	CAIS-49678	LOCK: Tube; type 302 stainless steel.	Secure tubes	Birtcher Type 929-1	B-23A-6213	4	1	2
E-110	CAIS-49679	LOCK: Tube; type 302 stainless steel.	Secure tubes	Birtcher Type 926-B	B-23A-6210	1	1	1
E-111	CAIS-49496	LOCK: Tube; type 302 stainless steel.	Secure tubes	Birtcher Type 926-A	B-23A-6209	1	1	1
E-112		INSULATOR: Washer; Vellutex.	Insulating washer	Felt Products	A-29G-3236	8		16
E-113		ADAPTER: For crystal housing.			A-55A-6803	1	1	2
F-101	1034-4	FUSE: Glass; 250 V; 2 amp.	Fuse	Buss Type 4AG2	A-46B-4871	2	20	100
F-102		See F-101.	Fuse					
I-101		LAMP: Bayonet; 6.3 V; 250 amp; Type 44; Max. 8 V.	Pilot lamp	Tung-Sol	A-46A-1621	1	1	6
J-101	CPH-49194	RECEPTACLE: Chassis or box type.	Input receptacle	Amphenol Type 83-1R	A-55A-2071	3	1	4
J-102	49470	RECEPTACLE: Type N.	Output receptacle	Astatic Type B-7570	A-55A-6424	1	1	2
J-103	CHU-49676	RECEPTACLE: Twist lock; 2 screw type contacts.	AC receptacle	Hubbell Type 7466	A-19A-6154	1	1	2
J-105	CSX-49195	RECEPTACLE: Plug assembly; dielectene insulation.	Receptacle on video attenuator and dummy load	Selectar Type PLPT-5	A-55A-6309	2	1	2
L-101		INDUCTOR: Choke coil; single wind cam .046; wire 38SSE; $\frac{1}{4}''$ x $\frac{11}{16}''$ with 2 holes for wire .040 ID; Ind at 1000 cps—1 microhy.	Frequency compensation V101		A-207-1391	3	1	3
L-102		See L-101.	Frequency compensation V102					
L-103		See L-101	Frequency compensation V103					
L-104		INDUCTOR: Filter choke; dual; each section 9.5 HY at .060 amp. 420 ohms DC.	Power supply filter	Jeffersonelec no type no.	C-16B-4559-1	2	1	6
L-105		See L-104.	Power supply filter					
P-101		PLUG: Straight; male; part of W-102.	Plug line cord	Hubbell Type 7057	A-19A-6425	1	1	2
P-102	49284	PLUG: Navy dwg. No. RE-49F-188C, part of W-101 and W-103.	Plug on adapter and antenna cables	Astatic Type B-7525	A-55A-6469	3	1	6
P-103	49195	PLUG: Navy dwg. No. RE-49F-167, part of W-103 and W-104.	Plug on adapter cable	Astatic Type 7131	B-55A-2162	2	1	4
P-104	49190 Modified	RECEPTACLE: Connector plug; single contact; mica filled bakelite insulation. (Same as Amphenol type 83-1SP and Navy 49190 except .100 diam. hole through both sides (Part of W-104).	Plug on synchroscope cable	Amphenol Type 83-1SP Modified	B-55A-2244-1	1	1	2
R-101	RC20BF102K	RESISTOR: Fixed; composition; insulated; 1000 ohms ±10%; ½ W.	Input resistor	AB Type EB1021	A-9B1-62	2	1	5

MODEL: Detector Amplifier AN/UPA-1 **MAJOR ASSEMBLY: Amplifier AM-73/UPA-1**

Ref. Symbol	*Army Stock No. Navy Type No. British Ref. No.*	*Name of Part and Description*	*Function*	*Manufacturer and Designation*	*Drawing Number*	*Quantity per Major Unit*	*Quantity in Equip. Spares*	*Quantity in Stock Spares*
R-102	RC20BF224K	RESISTOR: Fixed; composition; insulated; 220,000 ohms ±10%; ½ W.	Grid resistor V101	AB Type EB2241	A-9B1-90	4	2	10
R-103	RC41BF322K	RESISTOR: Fixed; composition; insulated; 3300 ohms ±10%; 2 W.	Plate dropping V101	IRC Type BT-2	A-9B4-68	3	2	8
R-104	RC20BF112K	RESISTOR: Fixed; composition; insulated; 1100 ohms ±10%; ½ W.	Plate load V101	AB Type EB	A-9B1-63	2	1	5
R-105	RC20BF560K	RESISTOR: Fixed; composition; insulated; 56 ohms ±10%; ½ W.	Cathode resistor V101	AB Type EB5601	A-9B1-47	1	1	3
R-106		RESISTOR: Variable; gain control; composition; 1000 ohms; 2W; AB curve AB, type S.	Gain control cathode bias V101	AB Type J	A-10B-6468	1	1	5
R-107	RC20BF393K	RESISTOR: Fixed; composition; insulated; 39,000 ohms ±10%; ½ W.	Screen bleeder V101	AB Type EB3931	A-9B1-81	1	1	3
R-108		See R102.	Grid resistor V102					
R-109		See R103.	Plate dropping V102					
R-110		See R104.	Plate load V102					
R-111	RC20BF820K	RESISTOR: Fixed; composition; insulated; 82 ohms ±10%; ½ W.	Cathode resistor V102	AB Type EB8201	A-9B1-49	1	1	3
R-112	RC41BF751K	RESISTOR: Fixed; composition; insulated; 750 ohms ±10%; 2 W.	Screen supply dropping	IRC Type BT-2	A-9B4-6345	3	2	8
R-113		See R112.	Screen supply dropping					
R-114		See R112.	Screen supply dropping					
R-115		See R102.	Grid resistor V103					
R-116		See R103.	Plate dropping V103					
R-117	RC20BF122K	RESISTOR: Fixed; composition; insulated; 1200 ohms ±10%; ½ W.	Plate load V103	AB Type EB1221	A-9B1-6491	1	1	3
R-118	RC20BF121K	RESISTOR: Fixed; composition; insulated; 120 ohms ±10%; ½ W.	Cathode resistor V103	AB Type EB1211	A-9B1-51	1	1	3
R-119		See R102.	Grid resistor V104					
R-120		See R101.	Cathode resistor V104					
R-121	RC20BF470K	RESISTOR: Fixed; composition; insulated; 47 ohms ±10%; ½ W.	Screen dropping V104	AB Type EB4701	A-9B1-46	1	1	3
R-122	RC20BF514J	RESISTOR: Fixed; composition; insulated; 510,000 ohms ±5%; ½ W.	Video attenuator	AB Type EB5145	A-9B1-224	1	1	3

R-123	RC20BF225J	RESISTOR: Fixed; composition; insulated; 2.2 megohms ±5%; ½ W.	Video attenuator	AB Type EB2255	A-9B1-239	1	1	3
R-124	RC20BF121J	RESISTOR: Fixed; composition; insulated; 120 ohms ±5%; ½ W.	Dummy load	AB Type EB1215	A-9B1-137	2	1	5
S-101	ST-52K	SWITCH: Toggle; double pole; single throw; 10 amp; 125 V.	ON-OFF switch	CH Type 8823-K4	A-20C-6117	1	1	1
T-101	CJE-301566	TRANSFORMER: Power; primary 117.5 V; secondary #1 330 V.D.C. at 85 MA; secondary #2 5 V; secondary #3 6.3 V; secondary #4 6.3 V.	Power transformer	Jeffersonelec no type no.	D-12A-4560-1	1	1	3
V-101	JAN 6AC7	TUBE: Pentode amplifier; octal base.	Video amplifier			3	6	
V-102		TUBE: See V101.	Video amplifier					
V-103		TUBE: See V101.	Video amplifier					
V-104	JAN 6AG7	TUBE: Pentode amplifier; octal base.	Output tube			1	2	
V-105	JAN VR105	TUBE: Voltage regulator; octal base.	Voltage regulator			1	2	
V-106	JAN 5Y3GT	TUBE: High vacuum rectifier; octal base.	Rectifier			1	2	
W-101		CABLE: Antenna to detector; RG-9/U cable; overall lg. 5′; part 49284 (P-102) on each end.	Antenna cable	BRC	B-201-1492	1	1	2
W-102		CORD: Line cord; lg. 6′; with Part X-108 at one end and Part P-101 at other end.	AC line cord	BRC	B-201-1372	1	1	2
W-103		CABLE: For detector; RG-9/U cable; overall lg. 6′; part 49284 (P-102) at one end and P-103 at other end.	Adapter cable	BRC	B-201-1493	1	1	2
W-104		CABLE: Synchroscope to detector; RG-63/U cable; overall lg. 36″; part P-103 on one end and part P-104 at other end.	Synchroscope cable	BRC	B-201-1511	1	1	2
X-101	CMG-49557-A	SOCKET: Tube; bakelite; 8 prong octal.	Tube socket V101	Cinch Type 9950	A-15B-1452	6	3	6
X-102		See X-101.	Socket V102					
X-103		See X-101.	Socket V103					
X-104		See X-101.	Socket V104					
X-105		See X-101.	Socket V105					
X-106		See X-101.	Socket V106					
X-107		SOCKET: Lamp; brass; bayonet base; screw type.	Pilot light socket	Drake Type #40	A-47A-6136	1	1	1
X-108	CHU-49667	SOCKET: Twist lock; bakelite; part of W-102.	Socket for line cord	Hubbell Type 7464	A-19B-6155	1	1	2
Z-101	TS-288/UPA-1	IMPEDANCE: Dummy load; a resistive dummy load, used with cable connecting detector-amplifier AN/UPA-1 and synchroscope TS-28/UPN. On ends are receptacles J105 and J101, Navy type Nos. 49194 and 49195.	Dummy load	BRC	B-207-1393-2	1		1

TABLE OF REPLACEABLE PARTS

MODEL: Detector Amplifier AN/UPA-1 **MAJOR ASSEMBLY: Amplifier AM-73/UPA-1**

Ref. Symbol	*Army Stock No. Navy Type No. British Ref. No.*	*Name of Part and Description*	*Function*	*Manufacturer and Designation*	*Drawing Number*	*Quantity per Major Unit*	*Quantity in Equip. Spares*	*Quantity in Stock Spares*
Z-102	CN-25/UPA-1	IMPEDANCE: Video voltage divider; used between detector-amplifier AN/UPA-1 and synchroscope TS-28/UPN to prevent overdriving of the latter by the former, frequency compensation is employed. On ends are receptacles J105 and J101, Navy type Nos. 49194 and 49195.	Video voltage divider	BRC	B-207-1393-1	1		1
Z-103	TPS-51-PB/10	IMPEDANCE: R-F attenuator, 10DB attenuation.	R-F attenuator		B-55A-6914	1		1
Z-104	TPS-51-PB/20	IMPEDANCE: R-F attenuator, 20DB attenuation.	R-F attenuator		B-55A-6913	1		1
CR-101	CHS-1N23	RECTIFIER: Crystal capsule; base .294″ diam.	Detector	Sylvania Type 1N23	A-8K-6467	1	1	50

LIST OF MANUFACTURERS

AB
Allen Bradley Company
136 W. Greenfield Ave., Milwaukee, Wis.

Amphenol
American Phenolic Corporation
1830 S. 54th Ave., Chicago, (50) Ill.

Astatic
Astatic Corporation
830 Market St., Youngstown, Ohio

BRC
Belmont Radio Corporation
5921 W. Dickens St., Chicago, (39) Illinois

Birtcher
Birtcher Corporation
5087 Huntington Dr., Los Angeles, Calif.

Buss
Bussman Manufacturing Company
2538 W. University St., St. Louis, (7) Mo.

Cinch
Cinch Manufacturing Company
2335 W. VanBuren St., Chicago, (12) Ill.

Condenser Corp.
Condenser Corporation of America
South Plainfield, N. J.

C-H
Cutler-Hammer, Inc.
1333 W. St. Paul Ave., Milwaukee, Wis.

Drake
Drake Manufacturing Company
1713 W. Hubbard St., Chicago, (22) Ill.

Felt Products
Felt Products Manufacturing Company
1506 Carroll Ave., Chicago, Illinois

Genceraco
General Ceramics Company
Crows Mill Road, Keasbey, N. J.

GE
General Electric Co.
1 River Road, Schenectady, N. Y.

Haynes
Wm. Haynes Company
108 Massachusetts Ave., Boston, Mass.

Hubbell
Harvey Hubbell Corporation
319 N. Albany, Chicago, Illinois

IRC
International Resistance Company
1100 Terminal Commerce Bldg., Philadelphia, Pa.

Jeffersonelec
Jefferson Electric Company
910 25th Ave., Bellwood, Illinois

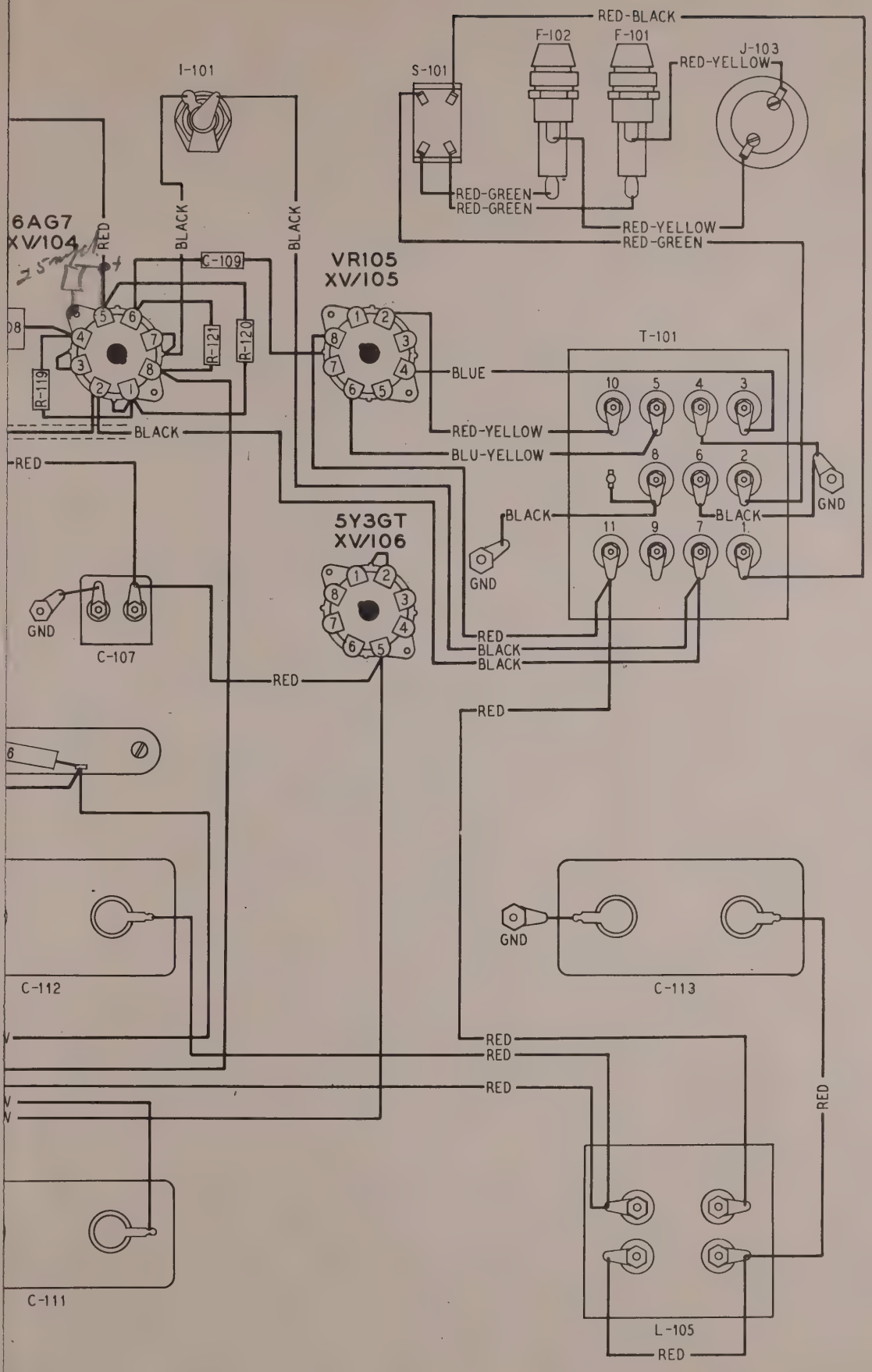
Kurz-Kasch
Kurz-Kasch
1417 S. Broadway, Dayton, (1) Ohio

Micamold
Micamold Radio Corporation
1087 Flushing Ave., Brooklyn, N. Y.

Selectar
Selectar Manufacturing Co.
21-10 49th Ave., Long Island City, N. Y.

Sylvania
Sylvania Industrial Corporation
4406 Chanin Bldg., New York, N. Y.

Tung-Sol
Tung-Sol Lamp Works, Inc.
95 8th Ave., Newark, N. J.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F-102
F-101
J-103
RED-YELLOW
S-101
I-101
RED-GREEN
RED-GREEN
RED-YELLOW
RED-GREEN
6AG7
XV/104
RED
BLACK
BLACK
C-109
VR105
XV/105
R-121
R-120
R-119
T-101
BLUE
RED-YELLOW
BLU-YELLOW
BLACK
BLACK
BLACK
GND
GND
5Y3GT
XV/106
GND
C-107
RED
RED
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BLACK
RED
C-112
GND
C-113
RED
RED
RED
RED
C-111
L-105
RED

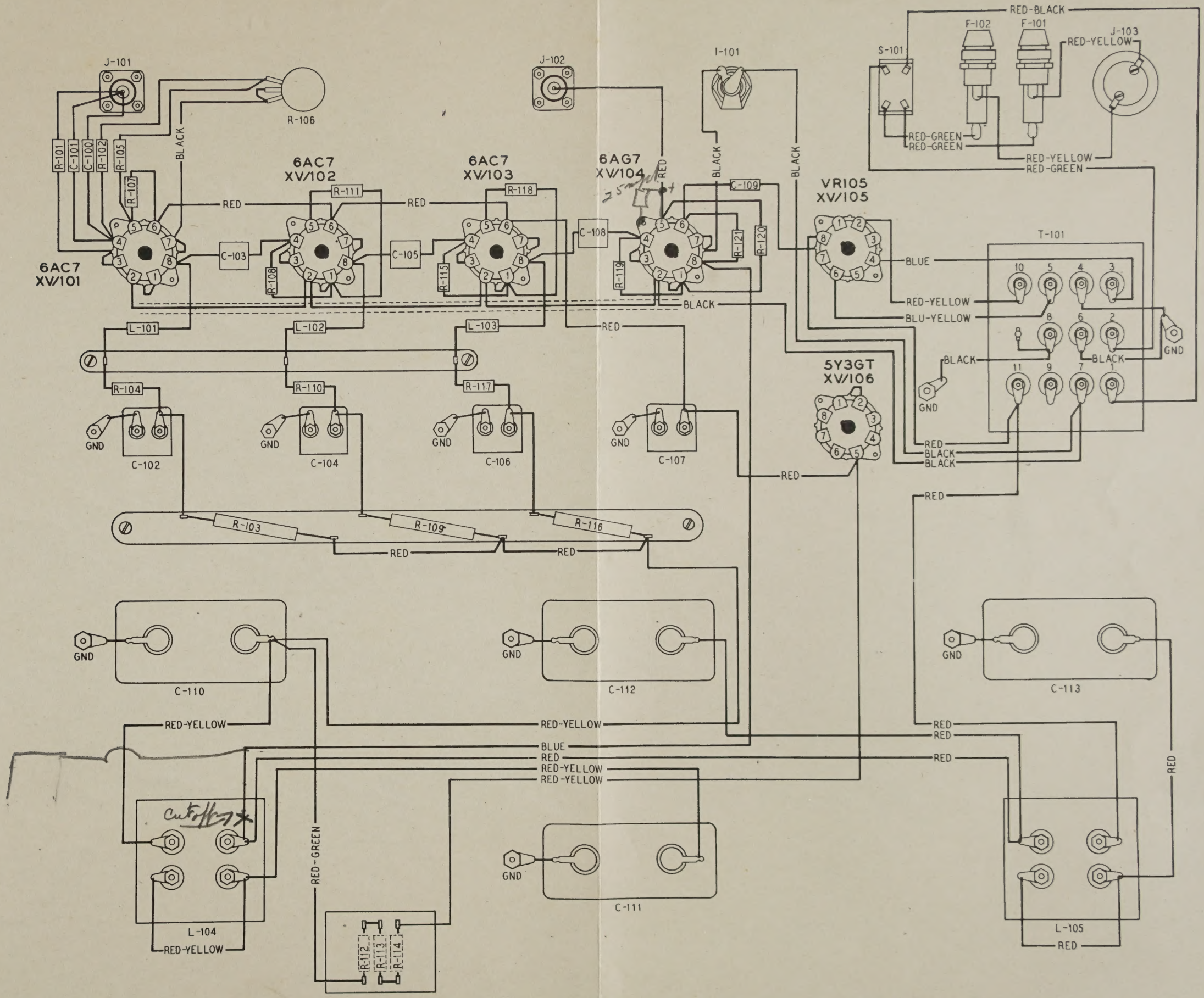

Figure 7-1—Amplifier AM-73/UPA-1, Wiring Diagram